INTRODUCTION

Information in This Report

Individual chapters in this report provide information on compliance with regulations, general information about the monitoring program and significant activities in calendar year (CY) 2003, summaries of the results of radiological and non-radiological monitoring, calculations of radiation doses to the population within 50 miles (80 kilometers [km]) of the site, and information about practices that ensure the quality of environmental monitoring data. Graphs and tables illustrate important trends and concepts. The bulk of the supporting information and data is found in Appendices B through L[C], included on the attached compact disk (CD), as referenced in the text[C].

Appendix A, included with the text, contains maps showing on-site and off-site sampling locations. Sample locations are designated by a coded abbreviation indicating sample type and location. (A complete listing of the codes is found in the index to Appendix A [pp. A-iv through A-vii].)

Appendix B[C] summarizes the CY 2003 environmental monitoring program and lists the kinds of samples taken, the frequency of collection, the parameters analyzed, the location of the sampling points, the monitoring and reporting requirements, and a brief rationale for the monitoring activities conducted at each location.

Appendices C through I[C] summarize radiometric, chemical analytical, and physical data from air, surface water, groundwater, fallout in precipitation, sediment, soils, biological samples (meat, milk, food crops, and fish), and direct radiation measurements and meteorological monitoring.

Appendix J[C] provides data from the comparison of results of analyses of identically-prepared samples (crosscheck samples) by both the West Valley Demonstration Project (WVDP or Project) and independent laboratories. The data include radiological concentrations and chemical parameters in crosscheck samples of air, water, soil, and vegetation.

Appendix K[C] provides a list of radiation protection standards set by the U.S. Department of Energy (DOE) that are most relevant to the operation of the WVDP. It also lists federal and state laws and regulations that affect the WVDP. Complete text of the WVDP Act has been added this year.

Appendix L[C] contains groundwater monitoring data for the New York State-Licensed Disposal Area, provided by the New York State Energy Research and Development Authority (NYSERDA).

Acronyms and abbreviations are used to shorten the text and make this document more readable. Each acronym is defined the first time it appears in a section of this report (e.g., the Annual Site Environmental Report [ASER]), after which the acronym alone may be used in the remainder of the section. For a complete listing of acronyms from the ASER, see the Acronyms and Abbreviations section at the end of this report. Other information that may be helpful is found in the References and Bibliography, Glossary, Units of Measure and Unit Prefixes, Scientific Notations, and Conversion Chart sections at the back of this report.

History of Fuel Reprocessing at the Western New York Nuclear Service Center

In the early 1950s, interest in promoting peaceful uses of atomic energy led to the passage of an amendment to the Atomic Energy Act that allowed the Atomic Energy Commission to encourage commercialization of nuclear fuel reprocessing as a way of developing a civilian nuclear industry. The Atomic Energy Commission made its technology available to private companies and invited proposals for the design, construction, and operation of reprocessing plants.

In 1961 the New York State Office of Atomic Development acquired 3,345 acres (1,354 hectares [ha]) near West Valley, New York and established the WNYNSC. Davison Chemical Co., together with the New York State Atomic Research and Development Authority (which later became NYSERDA), constructed and began operating a nuclear fuel reprocessing plant under a co-license issued by the Atomic Energy Commission (which later became the U.S. Nuclear Regulatory Commission [NRC] and the DOE). Nuclear Fuel Services, Inc. (NFS) was formed by Davison Chemical Co. to operate the plant as a commercial facility. NFS leased the property at the WNYNSC and in 1966 began operations to recycle fuel from both commercial and federally-owned reactors.

In 1972, while the plant was closed for modifications and expansion, new and more-rigorous safety regulations were imposed. Most of the changes concerned the disposal of liquid high-level radioactive waste (HLW) and the prevention of earthquake damage to the facilities. NFS decided that compliance with the new regulations was not economically feasible and in 1976 notified NYSERDA that it would not continue in the fuel-reprocessing business.

Following this decision, the reprocessing plant was shut down. Under the original agreement between the NFS and New York State, the state was ultimately responsible for both the radioactive wastes and the facility.

Description of the West Valley Demonstration Project

Numerous studies followed the decision by NFS to discontinue operations, which lead to the passage of Public Law 96-368, the West Valley Demonstration Project Act, in 1980. This Act authorized the DOE to demonstrate a method for solidifying the 600,000 gallons (2.3 million liters) of liquid HLW that remained at the West Valley site. Congress anticipated that the technologies developed at West Valley would be used at other facilities in the United States. (See Appendix K-3[C] for complete text of the WVDP Act.)

The purposes of the WVDP were to carry out the following activities: solidify the high-level radioactive waste that was left at the site from the original nuclear fuel reprocessing activities, develop suitable containers for holding and transporting the solidified waste, arrange transportation of the solidified waste to a federal repository, dispose of any low-level and transuranic radioactive waste resulting from the solidification of HLW, and decontaminate and decommission Project facilities used for solidification of radioactive waste.

DOE and NYSERDA entered into a Cooperative Agreement on October 1, 1980 (amended September 18, 1981). The Cooperative Agreement between the DOE and NYSERDA established the cooperative framework for implementation of the Project.

The WVDP Act specifically provides that the facilities and the high-level radioactive waste onsite shall be made available (by the state of New York) to the DOE without the transfer of title for as long as required to complete the Project. The facility's NRC license was amended in 1981 to allow the DOE to proceed at the Project under a Memorandum of Understanding. Although the lead agency for the WVDP is the DOE, under the Memorandum of Understanding the DOE and the NRC each have specific responsibilities related to the WVDP.

The former West Valley Nuclear Services Company, Inc., a subsidiary of Westinghouse Electric Corporation, was chosen by the DOE to be the management and operating contractor for the West Valley Demonstration Project. Site operations began at the WVDP in March 1982. The West Valley Nuclear Services Company, a unit of the Westinghouse Environmental Services Company (in 2003, the Energy and Environmental Division of Washington Group International), is the contractor for the WVDP.

The high-level waste, contained in underground storage tanks, had separated into two layers – a liquid supernatant and a settled sludge layer. Various subsystems were constructed that permitted the successful startup in May 1988 of the integrated radwaste treatment system (IRTS). The system removed most of the radioactivity from the liquid supernatant by ion exchange. The ion-exchange zeolite material then was stored in a spare underground tank for later processing. This allowed the major portion of the liquid to be treated as low-level radioactive waste. Treatment of the supernatant liquid from the high-level waste tanks through the IRTS was completed in 1990.

The next step in the process, washing the sludge with water to remove soluble constituents, began in late 1991 and was completed in 1994. In 1995, the contents of the HLW tanks were combined and the subsequent mixture was washed a final time. Vitrification of the high-level waste residues began in July 1996. In June 1998, the WVDP successfully completed the first phase of the vitrification campaign. By late 2002, the WVDP was conducting the final phase of the campaign by removing most of the waste in tanks 8D-1 and 8D-2. Vitrification was completed and the melter was shut down in September 2002. Activities for decontaminating the vitrification and support facilities were then initiated. These activities continued through 2003.

The following projects were initiated, continued, or completed in 2003:

Spent Fuel Shipping. After the original operator at the site, NFS, discontinued fuel reprocessing in 1972, 750 spent fuel assemblies remained in storage. These spent fuel assemblies were stored in the on-site fuel pool. During an early 1980s shipping campaign, 625 of the spent fuel assemblies were returned to the utilities that owned them. During 2001, the remaining 125 assemblies were prepared for transport to the Idaho National Engineering and Environmental Laboratory (INEEL) for interim storage. In July 2003, the assemblies were shipped to INEEL, completing this task.

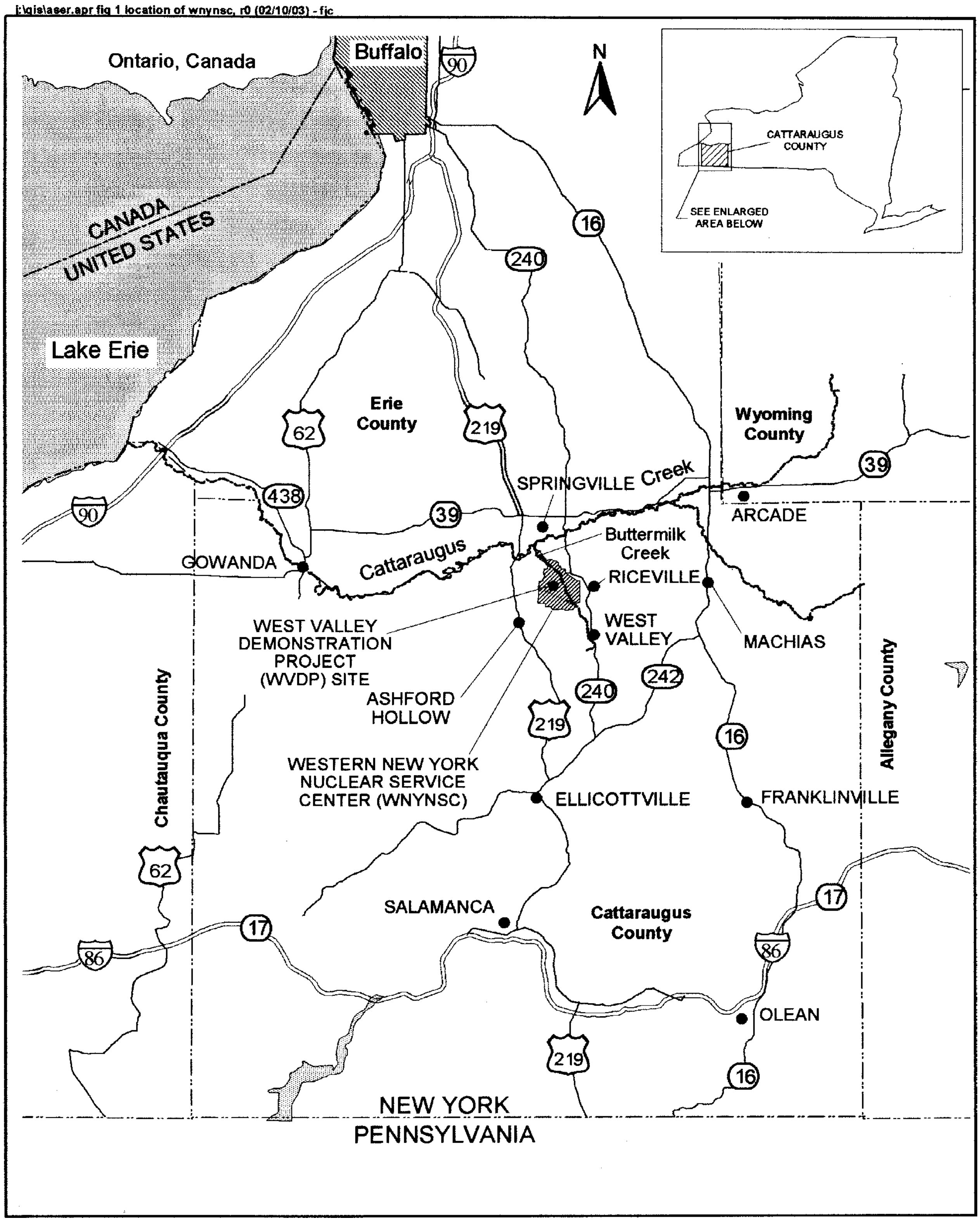

Figure INT-1. Location of the Western New York Nuclear Service Center

Decontamination of the Fuel Receiving and Storage Pools. After spent fuel, equipment, and debris were removed from the pools, they were drained, scrubbed and rinsed, the floors were grouted, surfaces were sealed, and a contamination fixative was applied. This project was completed in May 2003.

Decontamination of Cells in the Main Plant. Decontamination of cells and facilities in the main plant continued in 2003. The south product purification cell was decontaminated and work in the head end cells (the process mechanical cell and the general purpose cell) and extraction cell 2 continued throughout the year. Also in 2003, a plan for decontamination and dismantlement of the vitrification facility was prepared for implementation in 2004.

Waste Management. Part of the DOE's cleanup mission at the West Valley site is the disposal of low-level radioactive waste (LLW) that is generated through WVDP operations. In 2003, waste continued to be shipped off-site to storage facilities. (See Low-Level Radioactive Waste Shipping Program [p. 1-12].)

High-Level Waste Tank Lay-Up. Lay-up of HLW tanks 8D-1 and 8D-2 was completed in July 2003. Lay-up included isolating the tanks from the main plant, deactivating components, replacing and relocating pumps, and placing grout around pipe penetrations to reduce groundwater infiltration.

Remote-Handled Waste Facility. An on-site remote-handled waste facility was under construction in 2003. It will be used to prepare higher-activity wastes for shipment and disposal, with start-up projected for 2004.

Environmental Monitoring. Sitewide environmental monitoring and management of contaminated areas continued to ensure the safety of the public and the environment.

General Environmental Setting

The geography, socioeconomics, climate, ecology, physiography, and geology of the region are principal factors in assessing possible effects of site activities on the surrounding population and environment, and are an integral consideration in the design and structure of the environmental monitoring program.

Location of the West Valley Demonstration Project. The WVDP is located in northern Cattaraugus County, about 30 miles (50 km) south of Buffalo, New York (Fig. INT-1 [*facing page*]). The WVDP facilities occupy a security-fenced area of about 164 acres (66 ha) within the WNYNSC. This fenced area is referred to as the Project premises.

The WVDP is situated on New York State's Allegheny Plateau at an approximate average elevation of 1,300 feet (400 m). The communities of West Valley, Riceville, Ashford Hollow, and the village of Springville are located within approximately 5 miles (8 km) of the Project. Several roads and a railway approach or pass through the WNYNSC, but the public does not have access to the WNYNSC. Hunting, fishing, and human habitation on the WNYNSC generally are prohibited. A NYSERDA-sponsored program to control the deer population, initiated in 1994, continued through 2003. Limited access to the WNYNSC was given to local hunters, and community response has been favorable.

Socioeconomics. The WNYNSC lies primarily within the town of Ashford in Cattaraugus County. The nearby population, approximately 9,200 residents within 6.2 miles (10 km) of the Project, relies largely on an agricultural economy. No major industries are located within this area. The WVDP is one of the largest employers in Cattaraugus County.

The land immediately adjacent to the WNYNSC is used principally for agriculture and arboriculture. Cattaraugus Creek is used locally for swimming, canoeing, and fishing. Although some water to irrigate nearby golf course greens and tree farms is taken from Cattaraugus Creek, no public potable water supply is drawn from the creek downstream of the WNYNSC before the creek flows into Lake Erie south of Buffalo, New York. Water from Lake Erie is used as a public drinking-water supply.

Climate. Although there are recorded extremes of 98.6°F (37°C) and -43.6°F (-42°C) in western New York, the climate is moderate, with an average annual temperature (1971–2000) of 48°F (8.9°C). Rainfall is relatively high, averaging about 41 inches (104 cm) per year. Precipitation in 2003 totaled 41 inches (104 cm), equal to the long-term average. Precipitation is evenly distributed throughout the year and is markedly influenced by Lake Erie to the west and, to a lesser extent, by Lake Ontario to the north. Regional winds are generally from the west and south at about 9 mph (4 m/sec).

Biology. The WNYNSC lies within the northern deciduous forest biome, and the diversity of its vegetation is typical of the region. Equally divided between forest and open land, the site provides a habitat especially attractive to white-tailed deer and various indigenous migratory birds, reptiles, and small mammals. No species on the federal endangered-species list are known to be present on the WNYNSC.

Geology and Hydrology. The geologic sediments beneath the WVDP site include a sequence of glacial sediments above shale bedrock. The site is divided by a stream valley into two areas: the north plateau and the south plateau.

The uppermost layer on the south plateau is a silty clay till, the Lavery till. Weathering has fractured the near-surface sediments. Groundwater flows through this weathered till horizontally to the northeast and vertically downward. Groundwater flow in the unweathered till, beneath the weathered till, is predominantly downward at a negligible rate.

A Killdeer (Charadrius vociferus) Protects Her Nest

On the north plateau, a permeable alluvial sand and gravel layer overlies less-permeable glacial sediments (i.e., the Lavery till, the Kent recessional sequence, and the Kent till). Groundwater flow is predominantly horizontal, toward the northeast, discharging along the plateau’s edge. Within the Lavery till on the north plateau is a silty, sandy layer of limited extent, the Lavery till-sand.

The Kent recessional sequence underlies the Lavery till beneath both the north and south plateaus and is composed of silt and silty sand with localized pockets of gravel. Groundwater in this unit flows to the northeast with discharge to Buttermilk Creek.

Environmental Monitoring Program

The WVDP's environmental monitoring program began in February 1982. The primary program goal is to detect and evaluate changes in the environment resulting from Project or pre-Project activities and to assess the effect of any such changes on the human population.

The monitoring network and sample collection schedule have been structured to accommodate specific biological and physical characteristics of the area. Among the several factors considered in designing the environmental monitoring program were the kinds of wastes and other by-products resulting from the processing of HLW; possible routes that radiological and nonradiological contaminants could follow into the environment; geologic, hydrologic, and meteorologic site conditions; quality assurance standards for monitoring and sampling procedures and analyses; and the limits and standards set by federal and state governments and agencies. When new processes and systems become part of the Project, appropriate additional monitoring is provided. As processes are completed, unnecessary monitoring is eliminated from the program.

Monitoring and Sampling. The environmental monitoring program consists of on-site effluent monitoring and on- and off-site environmental surveillance to measure both radiological and nonradiological constituents. (See the Glossary for more detailed definitions of *effluent monitoring* [p. GLO-3] and *environmental surveillance* [p. GLO-4].) Monitoring and surveillance include both the continuous recording of data and the collecting of soil, sediment, water, air, and other samples at specific times.

Monitoring and sampling of environmental media provide two ways of assessing the effects of Project or pre-Project activities. Monitoring generally is a continuous (or periodic) process of measurement that allows rapid detection of any changes in the levels of constituents that could affect the environment. Sampling is the collection of media at specific times; sampling is slower than direct monitoring to indicate changes in constituent levels because the samples must be analyzed in a laboratory. However, sample analysis allows much smaller quantities of radioactivity or chemical concentrations to be detected.

Permits and Regulations. Data gathering, analysis, and reporting to meet stringent federal and state requirements and standards are an integral part of the monitoring program. The 2003 program met the requirements of DOE Orders 450.1 (Environmental Protection Program), 5400.1 (General Environmental Protection Program, canceled early in 2003), 5400.5 (Radiation Protection of the Public and Environment), and 231.1A (Environment, Safety, and Health Reporting), and DOE Regulatory Guide DOE/EH-0173T (Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance). The environmental monitoring program also supports requirements of the Resource Conservation and Recovery Act §3008(h) Administrative Order on Consent.

The WVDP holds a New York State Pollutant Discharge Elimination System (SPDES) Permit as required by the New York State Department of Environmental Conservation, which regulates liquid effluent discharges containing nonradiological pollutants. The SPDES Permit identifies the outfalls where liquid effluents are released to surface water drainage systems and specifies the sampling and analytical requirements for each outfall.

For more information about air and SPDES Permits see the Environmental Compliance Summary (pp. ECS-7 through ECS-12). Environmental permits are listed at the back of the Environmental

Compliance Summary (Table ECS-8 [pp. ECS-26 and ECS-27]).

Radiological air emissions must comply with the National Emission Standards for Hazardous Air Pollutants regulations. Depending upon the potential to emit radionuclides, some radiological emission points must be permitted by the U.S. Environmental Protection Agency (EPA).

In addition, the site operates under a New York State-issued facility air-emission permit for non-radiological contaminants.

Exposure Pathway Monitoring

The major pathways for potential near-term movement of contaminants away from the site are surface water drainage and airborne transport. For this reason, the environmental monitoring program emphasizes the collection of air and surface water samples.

Samples are collected on-site from locations such as plant ventilation stacks, various water effluent points, and surface water drainage locations. Analyses of samples of air, water, soils, and biota from the environment surrounding the site would detect radioactivity that might reach the public from site releases. Extensive groundwater monitoring addresses the relatively slower subsurface pathways and provides surveillance of potential releases from solid waste management units.

Surface Water and Sediment Pathways. Process waters are treated by filtration and ion-exchange in a liquid-treatment facility, the LLW2. The treated water is sent to a series of on-site holding lagoons for testing before being discharged through a single outfall. (The locations of the lagoons are noted on Fig. A-2 [p. A-2].) Samples of this process water and the effluent at two other discharge points are collected in accordance with SPDES Permit and DOE requirements.

The samples are analyzed for radiological parameters, including gross alpha and gross beta, tritium, strontium-90, and gamma-emitting radionuclides, and for nonradiological parameters, including pH. Additional analyses of composite samples determine metals content, solids, biochemical oxygen demand, nitrates, nitrites, ammonia, sulfate, organic chemicals, and specific radionuclides.

In general, surface water samples are collected regularly and analyzed, at a minimum, for gross alpha and gross beta radioactivity, tritium, and pH. A smaller number of samples are analyzed for conductivity, chlorides, metals, volatile organic compounds, and other parameters. Potable water on the site is analyzed monthly for radioactivity and annually for chemical constituents.

Off-site surface waters, primarily from Cattaraugus Creek and Buttermilk Creek, are sampled upstream of the Project for background radioactivity and downstream to measure possible Project contributions. Sediments deposited downstream of the facility and at upstream background locations are collected annually and analyzed for gross alpha, gross beta, and specific radionuclides. (See Appendix C[C] and Appendix G[C] for water and sediment data summaries.)

Groundwater Pathways. Groundwater discharge at the WVDP site occurs as springs or seeps along stream channels, direct discharge to streams, evapotranspiration, vertical groundwater migration to underlying strata, and discharge to artificial draining systems and lagoons. All of these discharges vary with the seasons. Discharge from springs and seeps is highest during the spring. Evapotranspiration is at a maximum during the summer. Groundwater discharge is, in general, lowest during the winter because the ground surface is frozen, which minimizes recharge.

Routine monitoring of groundwater includes sampling for contamination and radiological indicator parameters (pH and conductivity, and gross alpha, gross beta, and tritium) and for specific analytes of interest such as volatile organic compounds, semivolatile organic compounds, metals, and radionuclides at selected monitoring locations. (See Table E-1 in Appendix E[C].)

Residential drinking water wells located near the site are sampled annually and analyzed for gross alpha and gross beta radioactivity, tritium, strontium-90, gamma-emitting radionuclides, pH, and conductivity.

Air Pathways. Permitted effluent air emissions are continuously monitored for alpha and beta activity. Alarms indicate any unusual rise in radioactivity. Air particulate sampling filters, which are retrieved and analyzed weekly for gross radioactivity, are also composited quarterly and analyzed for strontium-90 and specific gamma- and alpha-emitting radionuclides.

Tritium and iodine-129 also are measured in effluent ventilation air at some locations. Silica gel-filled columns are used at two of the effluent locations to collect water vapor that is then distilled from the drying agent and analyzed for tritium. These distillates are analyzed weekly. Six permanent samplers at effluent locations contain activated charcoal adsorbent that is analyzed for iodine-129; the charcoal is collected weekly and composited for quarterly analysis.

Off-site sampling locations include those considered most representative of background conditions and those most likely to be downwind of airborne releases. Among the criteria used to position off-site air samplers are prevailing wind direction, land usage, and the location of population centers.

Off-site air is continuously sampled at ten locations. Background samplers are located far from the site in Great Valley and Nashville, New York. (The Nashville sampling location was discontinued at the end of March 2003.) Nearby-community samplers are in Springville and West Valley, New York. (See Figs. A-12 and A-13 [pp. A-12 and A-13] for these four off-site air sampling locations.) Six samplers are located on the perimeter of the WNYNSC. (See Fig. A-5 [p. A-5].) Samples from these locations are analyzed for parameters similar to the effluent air samples. (See Appendix D[C] for air monitoring data summaries.)

Atmospheric Fallout. An important contributor to environmental radioactivity is atmospheric fallout. Sources of fallout include earlier atmospheric testing of nuclear weapons and residual radioactivity from accidents such as that which occurred at Chernobyl in the Ukraine.

Four site perimeter locations and one on-site location currently are monitored for fallout using pot-type collectors that are sampled every month. Long-term fallout is assessed by analyzing soil collected annually at each of the six perimeter and four off-site air samplers. Three additional on-site soil samples are taken annually. (See Appendix D[C] for fallout data summaries and Appendix G[C] for soil data summaries.)

Food Pathways. A potentially significant pathway for radioactivity to reach humans is through consuming produce, meat, and milk from domesticated farm animals raised near the WVDP and game animals and fish that live in the vicinity of the WVDP. Animal and fish samples from potentially-affected areas are gathered and analyzed for radionuclide content in order to reveal any long-term trends. Fish are collected along Cattaraugus Creek at locations downstream of the WVDP. Venison is sampled from deer whose range includes the WNYNSC. Control samples of both fish and venison are collected from background areas outside WVDP influence. Beef, milk, and produce samples also are collected at nearby farms and at selected locations well away from WVDP influence. (See Appendix F^{C} for biological data summaries.)

Direct Radiation Measurement. Direct penetrating radiation is measured using thermoluminescent dosimeters (TLDs) located on- and off-site. Measurement points within the site are placed near selected waste management units and around the inner security fence. Other locations are around the site perimeter and access road and at background locations remote from the WVDP. Forty-three measurement points were used in 2003. The TLDs are retrieved quarterly and are processed by an off-site service to obtain the integrated gamma exposure. (See Appendix H^{C} for a summary of the direct radiation data.)

Meteorological Monitoring

Meteorological data are continuously gathered and recorded at meteorological towers on-site and a nearby regional location south of the WNYNSC. Wind speed and direction, barometric pressure, temperature, dewpoint, and rainfall are measured on-site. Wind speed and direction are measured at the regional tower. These data are valuable for modeling both airborne dispersion and long-term hydrologic trends. In the event of an emergency, immediate access to the most recent meteorological data is indispensable for predicting the path and concentration of any materials that become airborne. (See Appendix I^{C} for meteorological data summaries.)

Quality Assurance and Control

The work performed by and through the on-site WVDP Environmental Laboratory is regularly reviewed by several agencies for accuracy and compliance with applicable regulations. Assessments of the laboratory routinely focus on proper recordkeeping and reporting, timely calibration of equipment, training of personnel, adherence to accepted procedures, and general laboratory safety.

The Project's Environmental Laboratory also participates in quality assurance crosscheck programs administered by federal agencies. (See Appendix J^{C} for a summary of crosscheck performance.) The performance of outside laboratories contracted to analyze WVDP samples also is regularly assessed.

Environmental monitoring management continues to strengthen the formal self-assessment program by developing and implementing new strategies and procedures for ensuring high-quality data. Experienced senior scientists and specialists in relevant disciplines follow an annual schedule of self-assessments, produce formal reports with recommended corrective actions, and track the actions as they are completed.

Environmental and Safety Performance Recognition

In August 2003, a self-assessment was conducted to confirm that the WVDP's integrated environmental, safety, and health management system continued to be effectively implemented at the WVDP. Results from the self-assessment were verified in the DOE's annual review, conducted in December 2003. In 2003 the WVDP continued the achievement level and practices worthy of a National Environmental Performance Track and

STAR-designated site. For a more-detailed discussion of the integrated safety management system, the environmental management system, and associated performance awards at the WVDP, see Integrated Safety Management System, STAR Status, EPA National Environmental Performance Track, and Environmental Management System on pp. ECS-16 and ECS-17.

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